agricultural research

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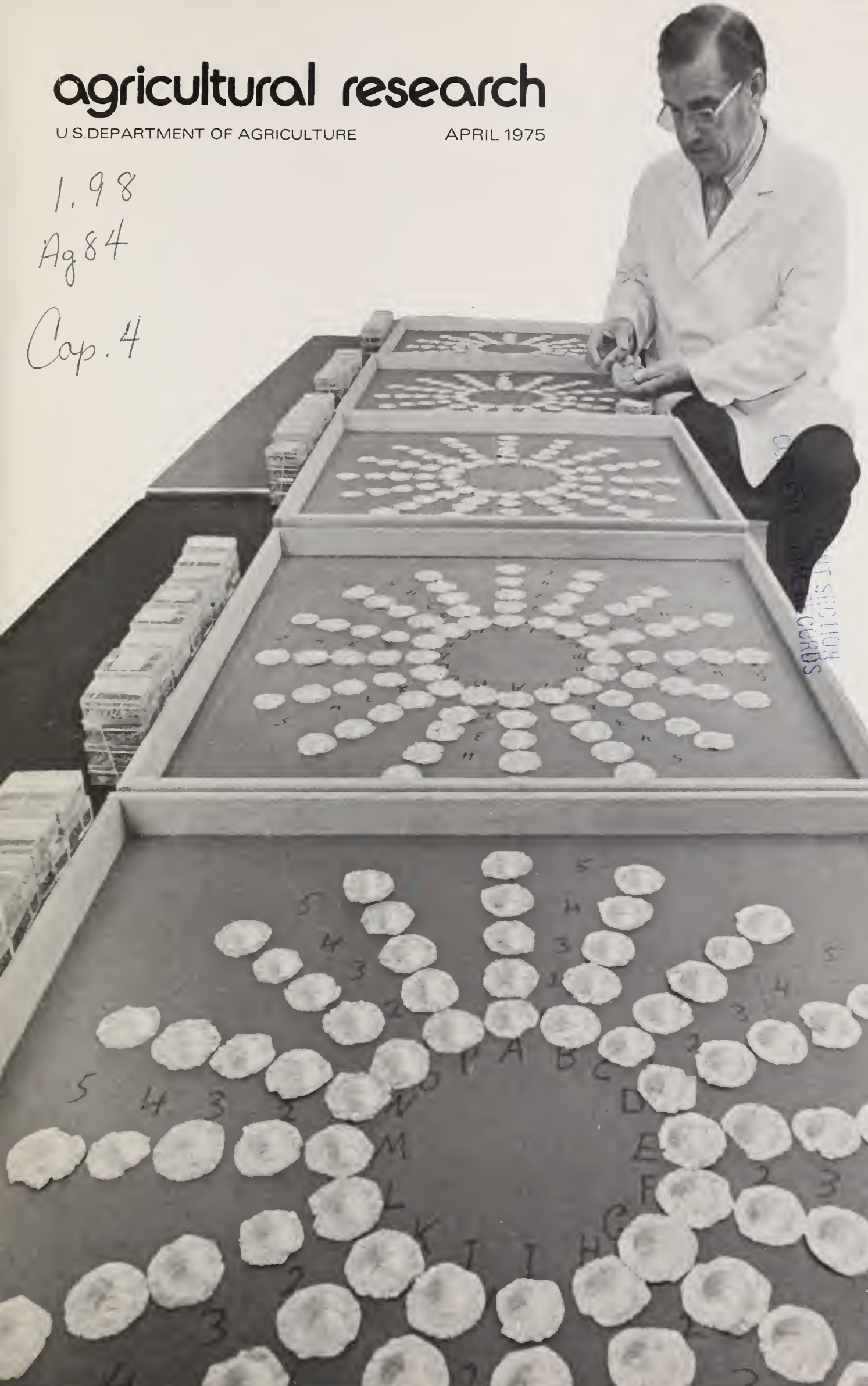

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April 1975/Vol. 23, No. 10

Always the Land

"The earth is our mother." This mystical saying of the American Indian expresses an elemental truth, for the phosphorus and calcium of the earth help build our flesh and bones. Everything else our bodies need, save air and sun, comes from the earth. Nature treats the earth kindly; man often treats her harshly. Man does so at his own peril, however, for extinct civilizations bear mute testimony that when the soil becomes depleted, human life vanishes.

Civilization, then, depends on maintaining the productivity of the land. Our rich soil has nourished the Nation through its difficult infancy and again through its wasteful adolescence. Now that we are a mature Nation, we must realize that any destruction of soil affects countryman and townsman alike—we all live from the land.

Keeping the land productive yet protected—a concept called conservation farming—draws upon a wealth of research-based technologies and practices. Some of them, the building of terraces and irrigation systems, of course, go far back into antiquity, their originators unknown. Modern research in soil conservation probably began in 1915 with the measurement of soil losses on Utah rangeland. Since then, researchers of many disciplines have developed effective methods for curbing the ravages of wind and water, thereby holding soil in place. Travelers of recent decades have witnessed the benefits as well as the bucolic beauty of such conservation in action: contour plowing, strip cropping, stubble mulching, grass waterways, farm ponds.

Despite significant progress, we must do more. Too many acres of land still require conservation treatment. Moreover, we need to observe sound conservation practices on lands, often marginal, now being returned to production to help feed a hungry world. ARS scientists and engineers are developing new and improved practices for application to the land by the Soil Conservation and the Extension Services, and others. For example, they are improving no-till and minimum-till systems of seedbed preparation, systems that scarcely disturb the soil while leaving a protective cover of crop residues. A major achievement is a soil loss equation to predict the erodibility of soils around the country. Much of their research is basic, probing into the secrets and nature of soils for, in the spirit of Roger Bacon: "the one rules nature who follows its rules."

We all owe a debt and a duty to the soil. It is each generation's responsibility, in its time, to cherish and wisely manage the soil, then pass it on unimpaired to posterity.

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COVER: In research to improve wheat varieties, entomologist H. Paul Boles prepares exposure units for testing weevil resistance. Rice weevils will be released to take their "choice" of the different wheat varieties on each foil disc. (0175X64–13). Article begins on page 10.

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The tiny wasp, Pediobius foveolatus, *is seen here on the Mexican bean beetle larva. Female wasps deposit 10 to 20 eggs in each beetle larva. As the young beetles emerge, they feed on the larva and lay their eggs on other larva in the soybean fields (BN–43506).*

Foreign wasp vs. bean beetle

AFTER the first successful year of watching *Pediobius foveolatus,* a beneficial wasp from India, spreading through Maryland's soybean fields, entomologist Allen L. Steinhauer can see lower insecticide costs for growers.

Dr. Steinhauer, of the Maryland Agricultural Experiment Station, is project leader for a 3-year study on alternative controls for Mexican bean beetles under an ARS cooperative agreement.

The Mexican bean beetle is a primary pest of soybeans in the Middle Atlantic States. Both the pest and the price of soybeans have been on a steady rise for 3 years, giving farmers more reason to use insecticides: protection of a more valuable crop. Last year chemical controls cost growers over $5 an acre.

Enter *P. foveolatus.* In the summer of 1973, Dr. Steinhauer released the parasitic wasps at six diverse sites. Within several weeks they were destroying bean beetle larvae in soybean fields as far as 40 miles from the dispersal sites. In the spring of 1974, the scientists increased the release sites to an average of 34 in each of 12 Maryland counties. From 200 to 1,000 wasps were freed from each site, with additional releases made later. In the summer of 1974, licensed aircraft insecticide applicators reported a drop in soybean field spraying of from ⅓ to ½ from 1973 levels. By September the wasps had parasitized about 83.3 percent of bean beetle larvae sampled in all counties.

The resulting decline in bean beetle numbers has been dramatic enough for Dr. Steinhauer to discuss possible large-scale control efforts.

"A routine of releasing the parasitic wasps each May when the beetle larvae are in sufficient numbers could potentially control the beetles," he says.

The program being designed in Maryland is for inoculative releases, meaning that the parasite must be re-released each year since it does not overwinter in Maryland.

"However, it is probably adaptable to any soybean growing area in the United States," says Dr. Steinhauer, "and an effective control program could probably be worked out by State agencies."

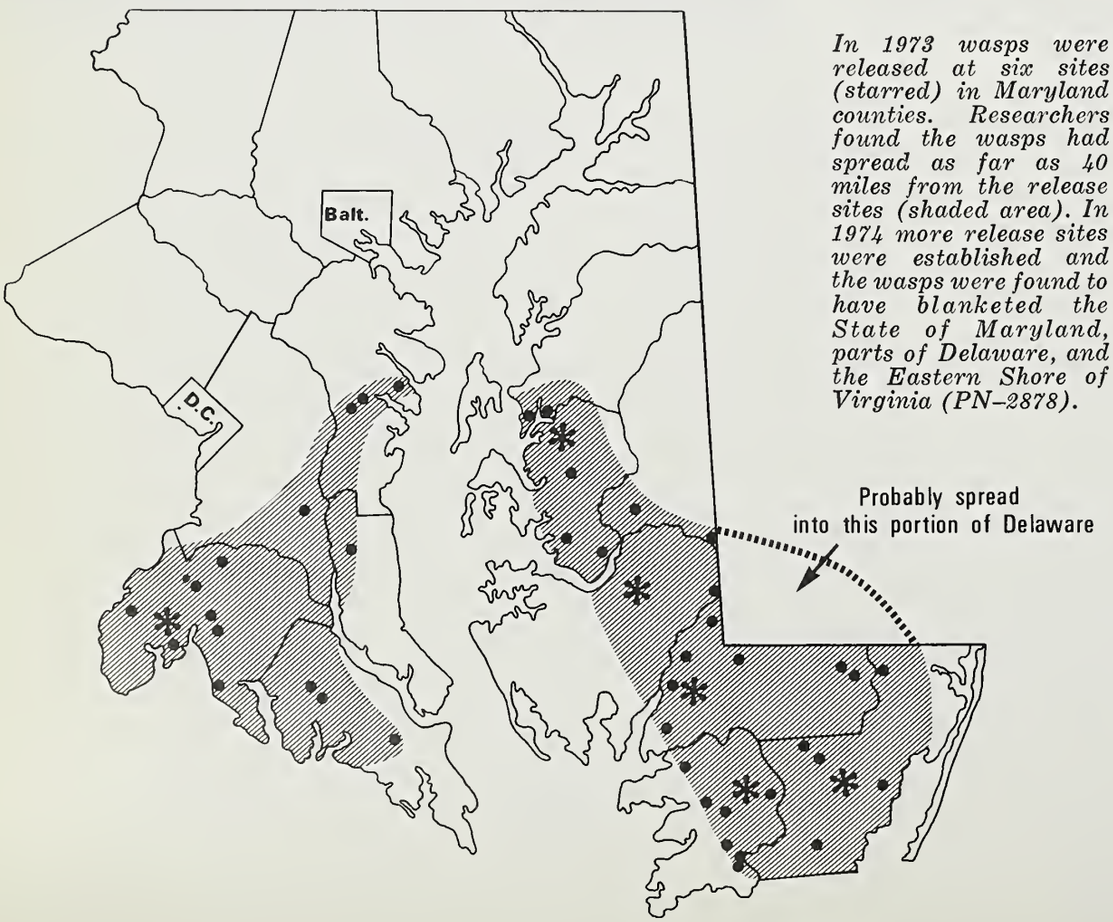
The soybean plant is ideal for biological controls. It can tolerate 30-percent defoliation before flowering, and

The adult Mexican bean beetles lay their eggs on the underside of the soybean leaf. Until the wasp release program began, the beetle had been a primary pest of soybeans in the Middle Atlantic States (BN–43507).

an additional 10 percent after its pods form, without a loss in bean yield. Growers can therefore afford to postpone insecticide use until this 40-percent threshold is reached. In the meantime, the tiny beetle-hunting wasp can be at work against the beetle.

Smaller than a gnat, *P. foveolatus* was discovered by ARS entomologist George W. Angalet during a search in India for insects beneficial to man. The non-stinging wasps were then imported into the United States under an ARS-sponsored Public Law 480 program at Bangalore, India. They were subsequently studied by ARS entomologists at Moorestown, N.J., and declared non-injurious to any other beneficial insect.

ARS tests in New Jersey in the 1960's proved the little wasp an effective weapon in ambushing the Mexican bean beetle. From 80 to 90 percent of the bean beetle populations at test sites were destroyed by *P. foveolatus*. ARS then provided Dr. Steinhauer with 6,745 additional wasps from stock obtained from the Commonwealth Institute of Biological Control, Bangalore, India.



In 1973 wasps were released at six sites (starred) in Maryland counties. Researchers found the wasps had spread as far as 40 miles from the release sites (shaded area). In 1974 more release sites were established and the wasps were found to have blanketed the State of Maryland, parts of Delaware, and the Eastern Shore of Virginia (PN–2878).

Here is how Dr. Steinhauer's method of distributing the wasp works. First, lima beans are planted in the greenhouse. When the plants have abundant foliage, large numbers of Mexican bean beetles are released. The beetles become established, reproduce, and their larvae feed on the underside of the bean leaves. Next, several thousand of the parasitic wasps are released into the greenhouse. The female wasps deposit from 10 to 20 eggs in each beetle larva.

Then the lima bean plants are lifted and transplanted to soybean fields. Baby wasps now use the beetle larvae as food, develop into adults, and emerge to find other beetle larvae on the soybean plants in the fields.

Another tested dispersal plan, employing the same principle, involved county extension agents who supervised nurse crops of snap beans situated at the edge of a soybean field.

Since the project started, Maryland researchers have sent the parasitic wasps to Florida, South Carolina, Virginia and Delaware where separate studies have begun.

In Delaware, experiment station entomologists have released the parasitic wasps at 44 sites within that state. □

Fusarium rot:

A thing of the past for potato growers?

FUSARIUM ROT, often the number one cause of losses to growers and planters of seed potatoes, conceivably might be a thing of the past if tubers or precut seed pieces are protected with experimental fungicides tested in Maine and North Carolina.

Two-to-threefold greater yields of potatoes resulted in tests with seed treated with either of two experimental fungicides, as compared to untreated check lots. Plant pathologists Simeon S. Leach of ARS and Lowell W. Nielsen of the North Carolina Agricultural Experiment Station at Raleigh, obtained these results on Pungo seed potatoes treated with 2-(4-thiazolyl)-benzimidazole and with methyl-l-(butylcarbamoyl)-2-benzimidazolecarbamate. These experimental materials must be registered with the Environmental Protection Agency by the manufacturers before they may be used on seed potatoes.

The treatments resulted in a better stand—more vigorous growth, fewer small plants, and correspondingly greater yields than from untreated seed. Pilot test yields for the control plot totaled 67 pounds per 100 feet of plot. With the first fungicide the yield was 159 pounds per 100 feet of plot, while potatoes treated with the second fungicide yielded 170 pounds per 100 feet.

These yields demonstrate a nearly 100-percent control of the disease organisms in storage, shipment, and preplanting periods as well as in the preemergence interval for the planted seed.

Dr. Leach obtained additional evidence of the effectiveness of the treatments in contamination studies with 120 barrels of Russet Burbank potatoes at Orono. After 5 months in storage, fewer than 0.5 percent of the treated tubers became infected, as compared with 4 percent of an untreated check lot. The control lot represents 375 barrels, or a loss of $2,225, from a 15,000-barrel storage facility.

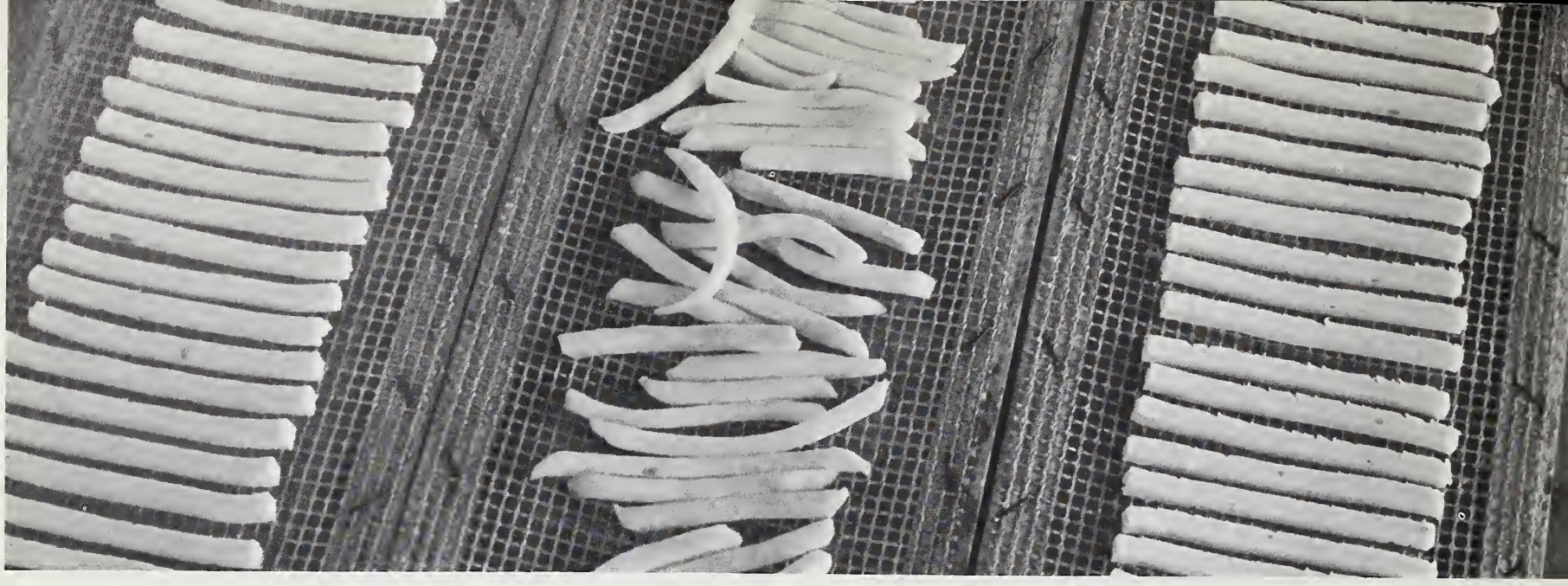
In the Maine and North Carolina experiments, Dr. Leach and Dr. Nielsen exposed the potatoes to conditions more severe than most growers usually experience. Potatoes with artificially-induced infections were used in the tests. Moreover, seed storage conditions in Maine and unusually cool, spring growing conditions in North Carolina favored development of fusarium rot. Accordingly, the good results obtained during these fungicide tests are all the more striking.

Both intact tubers and cut seed pieces were treated with the fungicides. The experimental compounds were diluted and applied at the same rate. They were diluted to a concentration of 2 pounds of fungicide per 100 gallons of water. They were then applied by an aerosol fogger at a rate of 1 gallon of diluted solution per 2,000 pounds of potatoes as the tubers passed over a roller table.

Dr. Leach employed conventional commercial management practices to maintain desirable storage environmental conditions for the intact tubers. Similar storage practices were used for the precut seed pieces, plus use of conventional wound healing procedures. Precut seed produced somewhat higher yields than did treated freshcut seed in North Carolina when wet and cold soil conditions prevailed at planting and the early part of the growing season. In Maine, however, with excellent growing conditions at planting and through the early stages of growth, treated, freshcut seed produced higher yields.

In addition to the fungicide experiments, decontamination was tested by washing and brushing potatoes before shipment. Yields in North Carolina showed a slight advantage in favor of washing, but Maine yields indicated no advantage for washing or brushing.

The Maine Life Sciences and Agricultural Experiment Station, Orono, cooperated in this research. □



French fries made by the new technique at the Western Regional Research Center are straight and uniform (left and right in photo) in contrast with commercially processed French fries (0175X76–37).

Mashing the French fry

Research chemist Masahide Nonaka examines cooked potato slabs as they emerge from the steam cooker. The equal thickness of the slabs insures uniform cooking of the potatoes (0175X76–3).

A NEW METHOD for producing French fries has the potential for reducing water pollution caused by present peeling processes, making use of small and misshapen potatoes, and producing a high quality product.

The process, under development at the Western Regional Research Center, Berkeley, Calif., makes French fries from extruded potato mash. Physical methods rather than chemical additives keep the product in the desired shape while improving its crispness and rigidity and causing it to absorb less oil during finish-frying.

Leaching is not necessary with the new process because of the very short finish-frying time—the time necessary to cook the fries in the home. Presently, potatoes used for French fries must be leached in water to lower the suger content which accumulates during storage. Excess sugar causes French fries to turn brown when they are fried.

The new French fry is crisp and rigid and has a mealy baked-potato interior. The fries also can be made to contain less oil and more solids than present commercial French fries.

Any size or shape potato can be used with the new method. Many varieties of potatoes not normally used for French fries make an excellent product. Moreover, the process makes use of bits and pieces which in standard French fry operations go into by-products.

In the new process, unpeeled, washed potatoes are cut into slabs of equal thickness so that they cook uniformly. The slabs are steam cooked after all rot and severely damaged spots are removed. After cooking, the potatoes are placed in a ricer-peeler where peels and defects such as blackspots are removed, and the potatoes mashed.

The mashed potatoes are then extruded through a die and cut into lengths about 4 or 5 inches long. This mash can also be molded into the French fry shape or any other shape. These shapes are then surface texturized by drying them with hot air at about 250° to 275° F., then steaming them at about 210° F. at atmospheric pressure, and finally drying again at 250° to 275° F. Surface texturizing helps maintain the shape of the French fry and improves frying properties.

Preservatives and binders to hold the mash together are not required for this process. However, these additives can be mixed with the mash prior to extrusion if the processor or consumer wants to enhance or change flavors and improve nutritional quality.

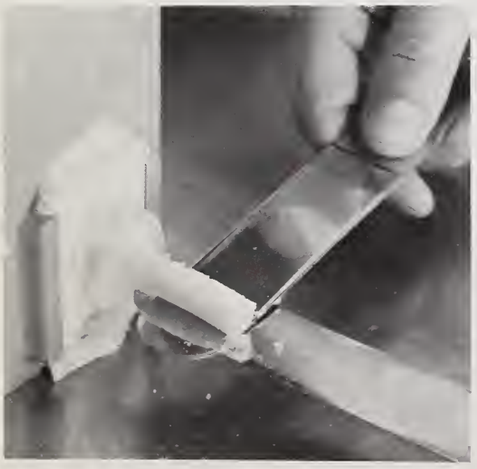
Extruded fries to be eaten in the home are fried, then packaged and frozen. It is only necessary to heat them in the oven for 8 to 10 minutes, thereby eliminating messy fat frying.

Extruded fries for institutional use are not fried prior to freezing. To prepare for eating, they are deep-fat fried at 365° F. for 1 to 1½ minutes.

The potato slabs are mashed through a ricer-peeler after cooking. The ricer-peeler eliminates the need for caustic or steam peeling of the potatoes, thus reducing pollution during the process (0175X76–36).

Pollution is greatly reduced by the new process because the ricer-peeler eliminates the need for caustic or steam peeling and the waste problems associated with them. The process, however, is not limited to using a ricer-peeler; conventional peeling equipment can be used if waste disposal is not a problem.

Research on the new process is still in progress. It is being conducted by plant physiologist Merle L. Weaver and research chemists Masahide Nonaka and Robert N. Sayre. □



The texture of the processed potato mash is shown as a laboratory technician catches it on spatulas as it comes from the shaping die (0175X75–13).

Renovating saltgrass meadows

THE PROBLEM of increasing forage production besets farmers and ranchers in many parts of the West where low rainfall, restrictions on deep well drilling, and lack of adequate irrigation water rule out customary pasture improvement practices.

Renovating saltgrass meadows is one way to get around the problem. These meadows receive ample moisture from natural seepage and are wet year after year. But drainage usually is poor and high water tables are common. These conditions create saline or alkali soils which severely limit their productivity. Many of these meadows could produce a higher yielding, more palatable forage crop if the present grasses could be replaced with a better forage species.

Presently, these meadows abound with saltgrass (*Distichlis stricta*), a forage plant that is tolerant of the salt but is of little value for livestock production. Saltgrass is very low in palatability and it invades existing stands of vegetation. Once saltgrass becomes established, it is difficult to control. Cattle graze around it, eating other species instead. This makes it all the easier for saltgrass to take over.

Saltgrass spreads by deep underground rhizomes, which makes control even more difficult. Rhizomes are strong and readily sprout new growth even after injury or burial under 12 or more inches of sediment.

Scientists at the Central Plains Experimental Range, Nunn, Colo., have learned that plowing, discing, and other mechanical means are not effective in controlling saltgrass. Tractors and equipment often become stuck in the meadows if cultivation is too intense.

Range scientist William J. McGinnies found that an application of 4 pounds of glyphosate (a chemical herbicide) per acre should effectively rid meadows of saltgrass. In field and greenhouse experiments such applications have killed up to 98 percent of the saltgrass.

Good quality underground water exists within 5 to 12 feet of the soil surface. This plentiful supply can be utilized by plants if they can reach the water table with their rooting systems.

Dr. McGinnies also studied and evaluated the soils that make up these meadows. He determined that most soils are capable of supporting valuable native forage species such as alkali sacaton (*Sporobolus airoides*). Grazing cattle like this palatable plant, and it is high in nutritive value. Although this plant may prove entirely satisfactory, Dr. McGinnies also is looking at several other potentially higher yielding species. These include tall wheatgrass (*Agropyron elongatum*), Russian wildrye (*Elymus junceus*), and smooth brome (*Bromus inermis*). All show some tolerance to these harsh growing conditions, and they are much easier to establish than alkali sacaton.

Dr. McGinnies is currently trying to determine the nitrogen requirements necessary to establish seeded stands of desirable species and obtain high forage yields. □

New: protein-rich and sugarless bread

BREAD made with a new formula is enriched with about 50 percent more protein than is supplied in bread now on the market.

Moreover, the bread's concentration of lysine, an essential amino acid making up the protein, is more than tripled. Its proteins are thus nearly comparable in nutritional quality to milk and meat proteins.

Another advantage of the formula is that it requires no sugar, a usual ingredient in bread. Almost 3 million pounds of sugar a day would be saved in this country if the sugar-free formula were used in baking an estimated 50 million, 1-pound loaves of white bread each day. Substitution of cereal malt for sugar in the formula would also reduce the cost of bread in developing countries that must import sugar.

The formula developed by ARS

Above: *Laboratory technician Bernadine Eichman removes the bread dough from a mixing bowl, records its temperature, rounds it by hand, and and places it in a fermentation pan (0175X47–25).* ***Below right:*** *The whole process begins as Mr. Shogren simultaneously collects yeast, salt, malt, and ascorbic acid to add to the flour, milk, and shortening. The ability to combine these ingredients in one step is vital to the preciseness of research baking (0175X47–12).* ***Below far right:*** *The dough is then mechanically mixed until it reaches its "point of minimum mobility" (0175X48–20).*

cereal chemist Karl F. Finney and food technologist Merle D. Shogren is applicable internationally and requires no changes in commercial breadmaking schedules or equipment. Some ingredients included in the formula, however, are not areadily available to those who bake bread at home.

The bread could be a principal source of protein, in developing countries and the United States, for children and adults whose diets are nutritionally deficient and who depend upon bread as a major food. Such protein-enriched breads can also serve as a supplemental food for those who are well fed.

The need for the new bread, Mr. Finney explains, stems from the fact that wheat protein is deficient in lysine. Scientists have known that adding high levels of a protein supplement such as soy flour would improve the nutritive value of wheat flour by increasing both total protein content and the amount of lysine in the protein. Two problems, however, limited practical application of this knowledge.

Earlier attempts to supplement wheat flour with soy flour produced poor-quality bread. Loaves were small, and both crumb grain and retention of freshness were impaired. Consumer acceptability was also restricted by the excessive browning and thickness of crust associated with high-protein bread baked with sugar.

These former shortcomings of protein-enriched bread have been corrected in the new sugar-free formula, which was developed at the U.S. Grain Marketing Research Center, in cooperation with the Kansas Agricultural Experiment Station, Manhattan.

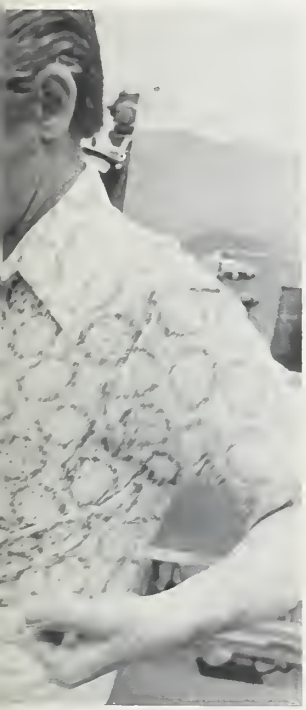
Yeshajahu Pomeranz, now director of the Center, and Mr. Finney were awarded a public patent in 1972 for a process by which high levels of protein supplement can be added to bread without impairing loaf volume, crumb grain, or retention of freshness. They found that replacing the usual 3-percent shortening with small amounts of glycolipids improved bread quality by making the wheat and soy protein compatible with each other.

Glycolipids are complexes of carbohydrates and fats that make up only about 0.3 percent of wheat flour weight but are responsible for such qualities as improved loaf volume. Subsequent studies indicated that sucrose palmitate or other purified sucroesters are fully as effective as wheat flour glycolipids.

Removal of sugar as an ingredient eliminated excessive browning and thickness of crust in bread made with the new formula. Mr. Finney explains that sugar converted from starch by cereal malt enzymes supports production of carbon dioxide for leavening, the function of sugar in the conventional formula. Barley, wheat, or triticale malts as flours or sirup may be used.

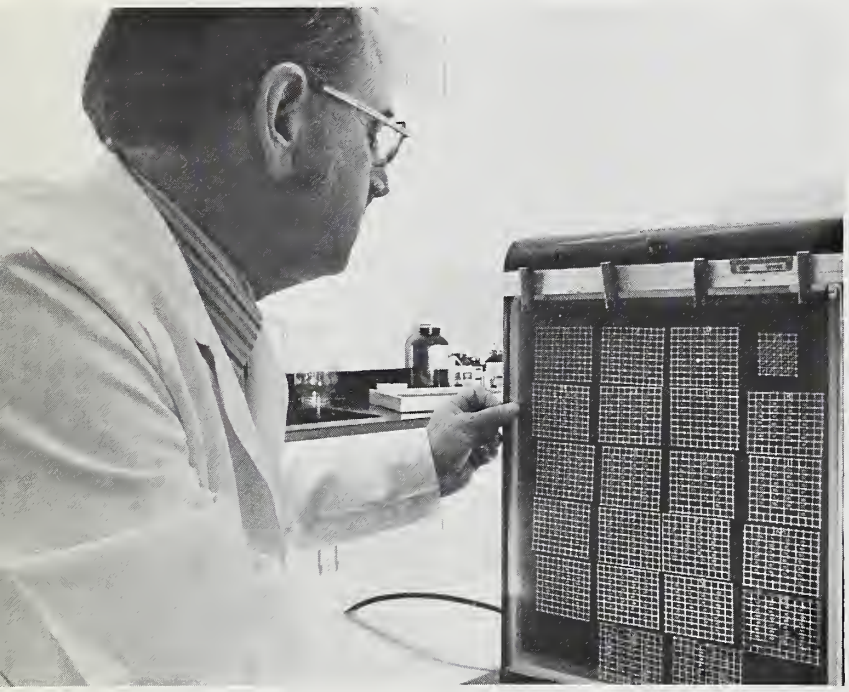
High levels of soy flour, as a protein supplement, are incorporated in the formula by replacing 10 percent of the wheat flour with soy flour and adding another 4 percent soy grits. Other variations from the usual commercial bread formula include replacing regular oxidants with ascorbic acid, as well as use of a small amount of cereal malt instead of 8-percent sugar, and 0.5-percent sucrose palmitate rather than 3-percent shortening.

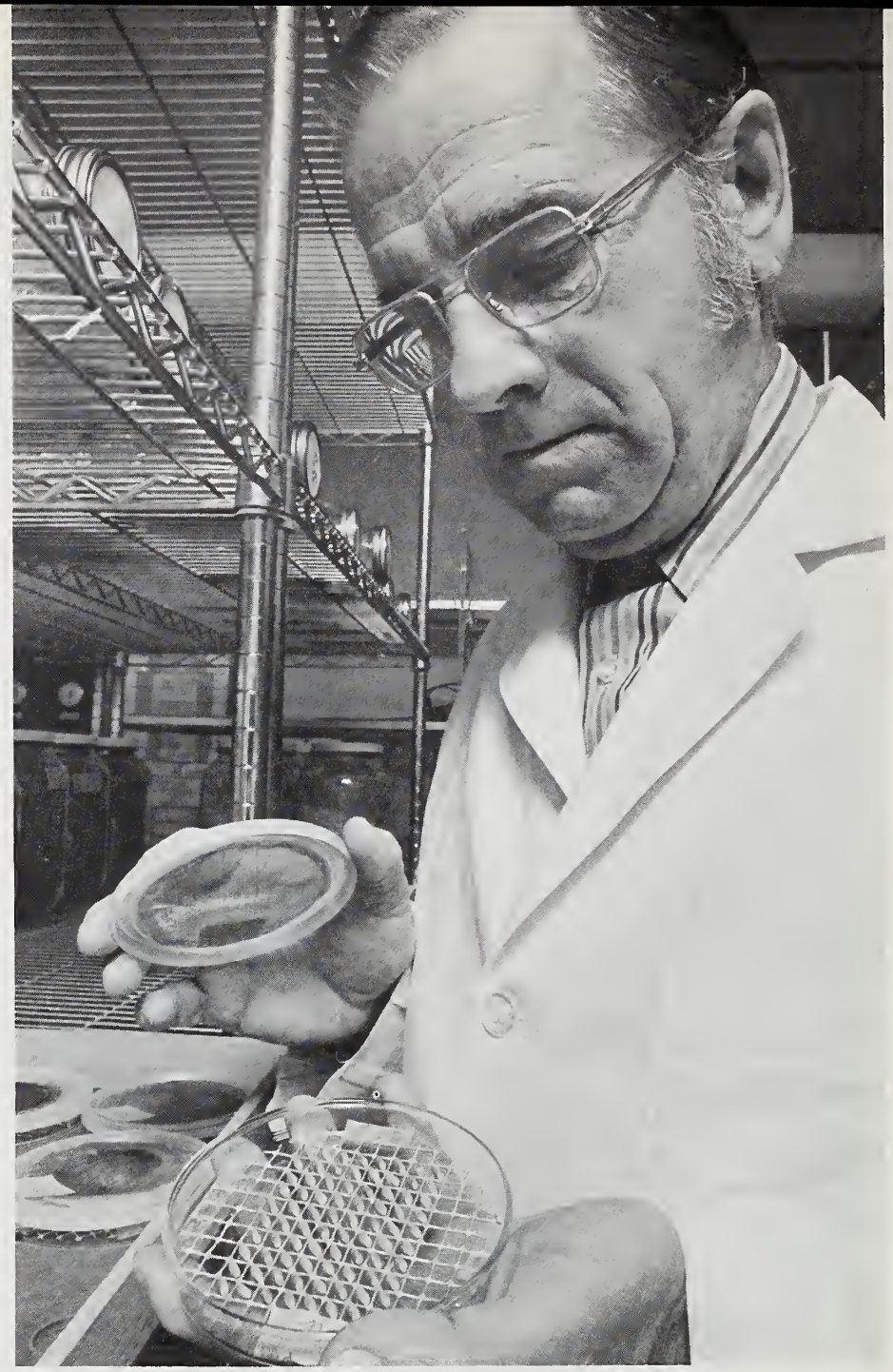
Sucrose palmitate would require Food and Drug Administration clearance for use in the United States. It has been approved for general food use in Japan and for certain food uses in several European countries. Mr. Finney says an acceptable high-protein bread could be made by reducing the amount of soy flour and substituting 3-percent conventional shortening for 0.5-percent sucrose palmitate. □



Above left: After fermentation the dough is run through a sheeting roll machine to remove excess gas. The process is similar to the kneeding done in home baking; the difference being the uniformity in the thickness of the dough made possible by the machine (0175X50–6). Above right: Mrs. Eichman weighs the finished product, fresh from the oven; and will also record the loaf volume (0175X49–20).

Right: *Dr. Boles examines a grid containing 20-grain samples of wheat used in a "free-choice" test to determine weevil resistance to different varieties of wheat (0175X65–15).*
Below: *The grids are later X-rayed for the presence of rice weevil larvae. The X-ray technique is used because the larvae form inside the wheat and are not externally visible (0175X64–27).*





Finding weevil-resistant wheats

DEVELOPING WHEATS able to withstand attack by stored-grain insects may be possible.

ARS entomologist H. Paul Boles has found signicant differences in resistance to one stored-grain pest, the rice weevil, in 15 wheat varieties. If the characteristics that make some wheats less attractive than others, or less able to support a population of rice weevils, can be identified, plant breeders may find ways of intensifying these characteristics in future wheat varieties.

Breeding for resistance to stored-grain insects has not been attempted. Wheats have been developed, however, that resist attack in the field by such insects as the Hessian fly, chinch bug, and wheat stem sawfly. All of the wheats tested by Dr. Boles and technician Ralph L. Ernst at the U.S. Grain Marketing Research Center, Manhattan, Kans., have relatively high susceptibility to the rice weevil.

In free-choice tests, the researchers released 240 rice weevils in a chamber containing 80, 20-grain samples of wheat. After a 7-day egg-laying period, they transferred the samples to a controlled environment room and held them there until larvae developed.

Sturdy, the most resistant variety, averaged 40 larvae per 100 grains in five tests, and Triumph, the least resistant, averaged 56.4 larvae. Infestation ranged from 31 to 69 larvae per 100-grain sample in individual tests.

In no-choice tests, three pairs of weevils were caged with 100-grain samples of each variety, and the samples were handled as in the first experiment. Differences in infestation were too small to be conclusive, but the least-damaged varieties were generally the same as in the free-choice tests. □

Keeping the broiler warm while conserving energy

A CHICKEN in every pot is a happy thought, but today's shopper knows that getting it there costs a lot more than when oldtime political campaigners voiced the slogan.

Cost of broiler chicken production—passed on to the consumer—is dependent on liquid petroleum gas (LPG) which has gone up 100 to 200 percent in price in 2 years. When fuel was a relatively minor part of total production cost, major broiler-producing areas were using from 40 to 100 gallons of LPG per 1,000 broiler chickens during the normal 8-week production period. Researchers hope to improve fuel utilization efficiency by evaluating types of insulation used in poultry house construction.

Agricultural engineers Frederick W. Harwood and Floyd N. Reece found that 30 to 35 gallons of LPG per brooder were required to maintain desirable brooding conditions with conventional equipment during the first 9 days of the growth period. Brooder manufacturers recommend starting with 500 to 1,000 chicks at 20,000 Btu's per hour per brooder. (A Btu, British thermal unit, is the quantity of heat required to raise the temperature of 1 pound of water 1° F.) Fuel use at that level could range from 30 to 70 gallons per 1,000 chicks for the first 9 days.

After the 3- to 4-week brooding phase, supplemental heat is usually provided to maintain optimum house temperature—70° to 75° F., based on feed utilization. If the rearing temperature is dropped below optimum, fuel costs are lowered, but feed costs are increased. Body weight is reduced, but not appreciably.

Building materials for poultry houses include sheet metal, plywood, wood fiberboard, and compressed-fiber sheathing. Insulation material includes blankets of fibrous wool formed from mineral or glass fibers, and rigid sheets or planks of expanded polystyrene and polyurethane. As a "rule of thumb," wood used in construction provides about one-half the resistance to heat flow provided by compressed fiber sheathing or insulation materials. "Expanded polyurethane has about twice the resistance of mineral or glass fiber wool or expanded polystyrene," Mr. Reece said.

Insulation in summer reduces death losses caused by heat prostration on hot, humid days. In winter, proper insulation ensures conservation of a major portion of the sensible (detectable) heat produced by the chickens. Sensible heat is used to heat enough ventilation air to remove the moisture produced by the chickens through respiration and excretion.

At the South Central Poultry Laboratory, Mississippi State, Miss., Mr. Reece illustrated the effect of insulation with two examples. Assume the following:

1. 7-week-old broiler chickens, producing sensible heat at 25 Btu's per hour per chick.
2. House, 40 feet by 200 feet (8,000 square feet).
3. 11,000 chicks, or 0.73 square foot per chicken.
4. 11,360 square feet of wall and roof area.

HOUSE "A": This house has wood framing, corrugated steel walls and roof—but no insulating materials. The outside temperature is 30° F. When the inside temperature increases to 49° F., the 275,000 Btu's per hour produced by the chickens would be equal to the heat loss from the house. There would be no heat available from the chickens to heat the ventilation air. Supplementary heat is required for that purpose.

HOUSE "B": Assume the same house construction, but add 2½ inches of glass fiber insulation in the roof and sidewalls. Now, less heat is needed to equal the heat loss from the house, and 235,000 Btu's per hour are available from the chickens to heat the ventilation air. That is equivalent to the heat energy of 2.6 gallons of propane per hour. Relative humidity would be 80 percent, which is a little higher than desirable, but could be tolerated until the weather warmed up.

For chickens, keeping and losing their cool is a seasonal "must"; insulation helps make it happen. □

the core of the problem

A MODIFIED soil sampler is in the offing. It prevents soil loss, minimizes soil contamination, and permits proportional sectioning of the soil core into desirable segments for bioassay or chemical analysis.

Agriculturists frequently need to determine the amount and specific location of fertilizers, animal wastes and agricultural pesticides in the soil. Such information is vital in tracing the fate of pesticides in the soil, and in preventing pollution of underground water and accumulation of high concentrations of fertilizer in the soil profile.

To accomplish this, representative soil samples are collected from treated or contaminated areas. Metal tubes and augers are the most common equipment types now used to collect soil samples. Separating the soil core into segments in the field using present equipment is very time-consuming and segment contamination is almost unavoidable.

ARS plant physiologist Edwart E. Schweizer and technician Dick Frey developed a sampler that collects soil cores to a depth of 30 centimeters (cm) and permits soil core separation into segments, quickly and accurately.

Their soil sampler consists of a handle, pin, metal tube holder, cutting tip, and a plastic liner. The liner fits snugly inside the tube holder, just above the cutting tip. The sampling tube is pushed into the ground by hand, and a soil core is thrust up into the plastic liner, to a maximum depth of 35 cm.

After reaching the desired soil depth, the soil sampler is withdrawn from the ground by hand. The plastic liner is removed from the tube, capped, identified, and taken to the laboratory to be frozen. Liners are later cut into segments with a saw, and soil is then removed as a segment sample.

Under normal conditions in a loam soil, two men can take 30 soil cores to

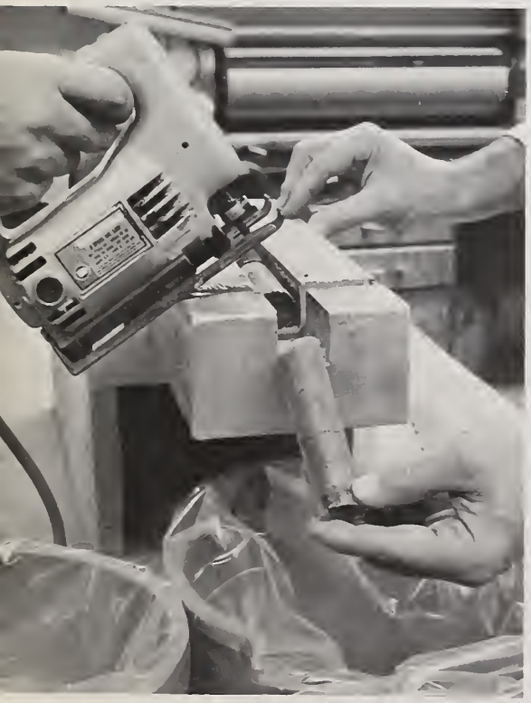
Above: *Technician Dick Frey looks as if he is taking a conventional soil sample; however, the newly developed soil sampler has a plastic core (0175X83–7).* ***Right:*** *Mr. Frey caps the plastic liner as he removes it from the sampler. The tube will then be marked for identification, taken to the laboratory intact, and frozen (0175X83–10).*

a 33 cm depth in 20 minutes. Additional time is required when soil is dry or rocky. Soil cores cannot be taken in wet soil because soil becomes compressed within the liners.

The method takes longer than do procedures using an open-sided tube. However, it offers several advantages over the open-sided tubes. None of the sample is lost in the field when the tube is withdrawn. Dry soil often blows out of open-sided tubes in high winds, or else sloughs off back into the hole. The soil core can be sectioned accurately and with little contamination later in the laboratory. Finally, the exact depth does not have to be taken when using this sampler because the desired depth can be exceeded and the extra soil can be discarded during sectioning.

Soil cores can be taken beyond a 33 cm depth, simply by constructing a longer tube holder. This sampler could be easily adapted for use with many commercial power samplers just by replacing the handle with an adapter. Plastic liners can be of any length. □

The plastic liners can be sawed into convenient segments and the samples removed. This allows a single sample to be analyzed several different ways without contaminating it (0175X83–29).



low pH reduces listeriosis

MAINTAINING a low pH in silage can cut down on the survival of bacteria causing listeriosis, a disease found in various forms in both animals and man.

Caused by a nonsporulating bacterium, *Listeria monocytogenes*, listeriosis can take the form of encephalitis in sheep and meningitis in man. *L. monocytogenes* attacks or may be harbored by as many as 33 mammalian and 17 fowl species. The encephalitic form of this disease in sheep produces symptoms similar to scrapie, generally causes death, and has been known to reach epidemic proportions in large feeder flocks.

The makeup of silage has long been suspect in outbreaks of listeriosis. ARS-sponsored Yugoslav research found that a high pH (alkaline) silage encourages the development of certain fungi, such as *Aspergillis* and *Penicillium*. These fungi break down certain amino acids in the silage and release chemicals that stimulate the metabolic activity of the disease organism.

To counteract this problem the Yugoslavs recommend that any additives to silage—nutritive compounds for example—should have a low pH. This step slows or prevents the development of fungi, thus indirectly reducing activity of the listeriosis bacteria.

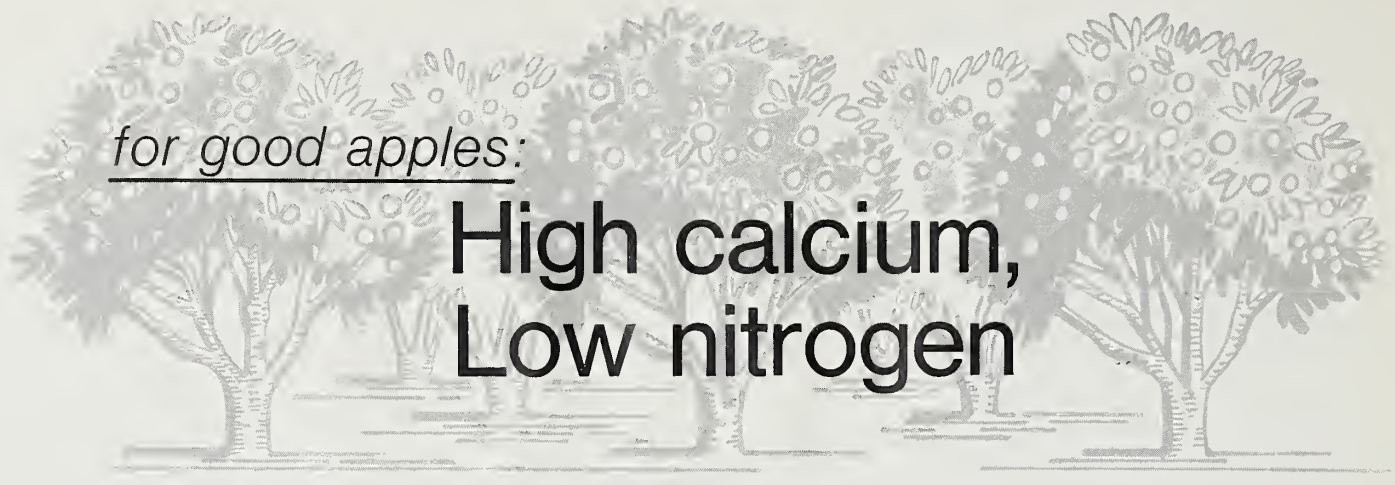
In other experiments, the Yugoslav scientists found that *L monocytogenes* could be isolated from the soil, litter, or open spaces where sheep were fed and from silage residues in empty silos 180 days after the sheep were removed from the area.

ARS animal pathologist Randall Cutlip, Ames, Iowa, says this is a high rate of persistence for a nonspore–forming bacterium that can cause disease in animals.

"Other results of the Yugoslav work," Dr. Cutlip said, "include the finding that stress increases susceptibility. Adverse climatic conditions and dietary deficiencies, such as insufficient vitamin A in feed, contribute to a higher incidence of listeriosis in sheep fed silage containing *L. monocytogenes*."

This Public Law 480 project was conducted under the direction of Dr. Zlatko Forsek at the University of Sarajevo, Sarajevo, Yugoslavia.

ALTHOUGH the importance of listeriosis as a disease of animals has long been recognized, the role of *L. monocytogenes* as a cause of human diseases has only recently been appreciated. Little is known about the transmission of the disease from animals to man. Sporadic outbreaks have been reported all over the United States and in many foreign countries. Susceptible hosts include cattle, goats, swine, rabbits, guinea pigs, foxes, raccoons, chinchillas, dogs, and chickens. Its second most important manifestation in humans is abortion near term and stillbirth. □



for good apples:

High calcium, Low nitrogen

GROWERS are aware that apples must be well supplied with calcium (Ca) if they are to be free from defects and store well. It has now been established that excessive nitrogen (N) can counteract the beneficial effects of Ca, so that not only adequate Ca, but a low N/Ca ratio, is important for apple quality.

Adequate Ca slows the apple's respiration rate so the fruit keeps longer. It also preserves the organization of cell membranes and helps in the synthesis of protein. Low Ca is responsible for substantial postharvest losses.

For these and many other reasons, plant physiologists Cornelius B. Shear and Miklos Faust, Beltsville Agricultural Research Center, have been recommending orchard practices that promote increased Ca content of the fruit.

Defects such as cork spot—hard, bitter spots that appear in the flesh of apples when their cells keep dividing locally—and bitter pit—depressed, dark areas on the surface of the fruit—have been directly associated with low fruit Ca (AGR. RES., March 1972, p. 12).

Since 90 percent of the Ca in mature apples accumulates during the first 6 to 8 weeks after full bloom, everything possible must be done to enhance Ca movement into the fruit during this period. Nitrogen fertilization must be limited to prevent the excessive growth of shoots which compete with the fruit for Ca. Though most of the N accumulates in the leaves, the rate of increase for a given increase in N supply is greater in the fruit than in the leaves. With an increase of N from 2 to 2.2 percent in the leaves, for example, fruit N might triple from 0.2 to 0.6 percent. Severe pruning also encourages competing shoot growth.

If N is supplied in the spring, it should be as nitrate or urea rather than in the ammonium form. Ammonium N lowers the ratio of fruit Ca to leaf Ca more than does nitrate N. Even though the ammonium is converted to nitrate in the soil, this takes time. If only as little as 1/7 of the N is available in the form of ammonium, the tree responds as an ammonium-fed tree, cutting down both Ca uptake and Ca movement into the fruit.

Mr. Shear and Dr. Faust found that though both bitter pit and cork spot are positively correlated with N and N/Ca ratio and negatively correlated with Ca, the N/Ca ratio is a more reliable indicator of probable incidence of both disorders than either N or Ca alone. They concluded that if leaf N exceeds 2.5 percent, at least 10 percent of the fruit is likely to show cork spot or bitter pit. It is virtually impossible, under orchard conditions, to get enough Ca into the fruit to overcome the effects of such high levels of N.

In another experiment, trees were grown continuously on either high or low levels of Ca. Some were shifted from low to high Ca in mid-June, and others were shifted from high to low Ca at the same time.

Both cork spot and bitter pit were nearly as severe on fruit from trees that received low Ca early in the season as on fruit from trees that received low Ca throughout the season. Supplying a high level of Ca late in the season could not compensate for the early deficiency of the element. □

Herbicides for soybeans

TWO experimental herbicides for soybeans fields, bentazon and metribuzin, provided excellent control of several annual broadleaf weeds that are seldom controlled by usually available herbicides. But weed scientists also found large differences in the effects of these herbicides on soybean varieties.

"Some varieties are severely injured or killed by these herbicides when they are applied at rates that cause little or no injury to other varieties," says ARS agronomist Loyd M. Wax, who led these studies at Urbana, Ill.

Bentazon, a postemergence herbicide, controls cocklebur, jimsonweed, smartweed and velvetleaf. Metribuzin, a preemergence herbicide, controls these same species.

Fortunately, the varieties that are most sensitive to bentazon are not commercially important, says Dr. Wax. Metribuzin, however, when applied at about double the prescribed rate, often severely injures a few commercially important soybean varieties, including Semmes and Tracy.

Results of the experiments are useful, not only for informing soybean growers about potential problems, but also for helping plant breeders avoid incorporating the trait for sensitivity to a herbicide into their breeding programs.

The scientists found that breeding lines of soybeans with high sensitivity to bentazon were also sensitive to the herbicide 2,4-DB. Further research may show reasons why some varieties are more sensitive to herbicides than others.

The ARS studies were conducted in cooperation with the Illinois Agricultural Experiment Station, Urbana. Metribuzin has been registered with the Environmental Protection Agency for use on soybeans. Bentazon has not been registered.

Side-by-side herbicide-treated (left) and non-herbicide treated soybean test plots are examined by Dr. Wax and cooperating University of Illinois weed scientist Fred W. Slife. The non-treated plot shows extensive damage from broadleaf weeds (0973X1461–21).

Dehydrating microscope samples

SCIENTISTS have reduced from several hours to about 1 minute the time required to dehydrate samples being prepared for examination with an electron microscope.

The new procedure involves chemical dehydration by immersing samples in 2,2-dimethoxypropane (DMP) to instantly convert water in the samples to methanol and acetone. Although dehydration is completed quickly, samples can be held in the DMP bath for extended periods without fear of deterioration.

Dehydration is a critical step in sample preparation. The procedure generally involves physically exchanging water for an organic solvent, such as ethanol or acetone, prior to embedding in plastic. Several changes of solvent are required to complete water removal.

The new procedure has been used successfully in preparing samples of algae, cottonseed, cotton leaves, pumpkin root tips, mouse liver, mouse pancreas, mouse tracheal cartilage, and mouse skeletal muscle.

The procedure, which does not require changes in other preparation steps, was developed by chemists Linda L. Muller and Thomas J. Jacks, Southern Regional Research Center, New Orleans.

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Alfalfa germplasm pools

GENETICALLY diverse sources of pest resistance and desirable agronomic traits in alfalfa are now available to breeders of improved varieties and hybrids for the North Central Region of the United States.

Two carefully produced collections of alfalfa genetic material, termed germplasm pools, are now available to breeders. NC–83–1 originated mainly from sources adapted to northern alfalfa areas and NC–83–2 is adapted to the southern part of the North Central States.

ARS agronomist William R. Kehr, Lincoln, Nebr., points out that the germplasm pools provide breeders with large quantities of seed from which they can select plants with favorable combinations of traits. Producing the pools was also a means of preserving valuable germplasm.

Both pools include varieties, experimental lines and combinations, previously released germplasm, and foreign plant introductions. NC–83–1 includes 94 domestic and 36 foreign sources; NC–83–2 includes 63 domestic and 45 foreign germplasm sources.

Most entries from domestic sources and all of the foreign introductions carry some resistance to one or more important disease, insect, or stem nematode. Seed of the pools was produced under conditions that maximized chances for intercrossing and recombination among the sources in each pool.

The alfalfa germplasm pools were developed under the NC–83 Regional Research Project and were jointly released by ARS and agricultural experiment stations in Alaska, Illinois, Indiana, Iowa, Kansas, Minnesota, Nebraska, South Dakota, and Wisconsin.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

Soil as soil mulch

GRAVEL is nature's most perfect mulch. It permits infiltration of great amounts of water, robs plants of very little water, and reduces evaporation rates because water must move as vapor across the large pores between the gravel.

Because gravel is not always available, ARS scientists tested soil clods or pellets treated with a water-repellent for effectiveness as a mulch. Soil clods or pellets could be screened from the soil or formed by machinery from a soil/water slurry.

Soil scientists Merle L. Fairbourn and Herbert R. Gardner tested seven soil clod and pellet treatments in the lab and on fields near Fort Collins, Colo. One treatment, using pellets about ¾-inch in diameter mixed with a sodium methyl silanolate and water solution, produced as good a mulch as gravel. In comparison with bare soil, this soil pellet treatment could reduce water losses due to evaporation by 30 to 40 percent.

Mr. Fairbourn said, "This savings in precipitation often means the difference between crop failure and success, especially here on the Central Great Plains."

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